

**Abstract**

Apparatus and methods for an improved plasma processing. A first power source alternates between high and low power cycles to produce and sustain a plasma, and a second power source alternates between high and low power cycles to accelerate ions toward the substrate being processed. Preferably, the power sources are synchronized such that the second power provides each high power cycle substantially during the time that the first power source provides each low power cycle. Commencement of each high power cycle provided by the second power source may be delayed for a period of time after each high power cycle provided by the first power source terminates. This approach allows electrons to cool off and accumulated charge on surface features of the substrate to dissipate before ions are accelerated toward the substrate for processing. The power sources may also be synchronized such that the both power sources are in a high power state during initial plasma power up to facilitate coupling power to the plasma and reduce problems associated with impedance mismatch between the plasma and the first power source.

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